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A Novel Multiple-Stub Ultra-Wide Band Antenna



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Biography

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Outline

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Abstract

This paper proposes a novel multi-stub ultra-wide band planar monopole antenna. The radiation patch of the antenna is composed of a pair of back-to-back E-shape-like stub elements.

The E-shape-like stub element is the extension of the E-shape stub element, adding two semi-circle elements at the back of the E-shape stub element and extending the top of the E-shape stub element with an inverted L-shape element with a “suspending hammer” element.

Two semi-circle slots etched on the rectangular ground which is extended make the ground with two step-like structures to realize ultra-wideband.

The antenna is printed on a substrate of the dielectric constant 4.6. The experiment results show that the bandwidth of the antenna is 3.2GHz-18.7GHz for S_{11} of less than -10dB.

Keywords: antenna; multi-stub; ultra-wide band; monopole

Antenna Design

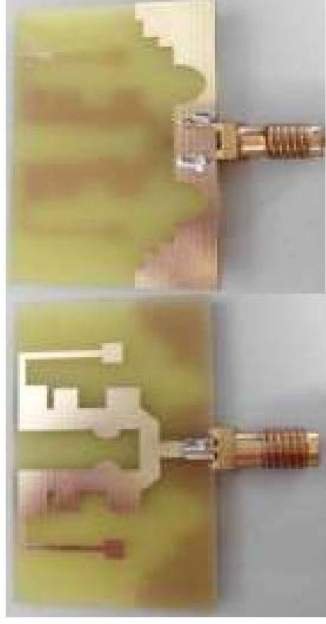


Fig.1 The model of the antenna

◆ A novel multi-stub ultra-wide band planar monopole antenna printed on a substrate of the dielectric constant 4.6.

- ◆ The bandwidth of the antenna is 3.2GHz-18.7GHz for S11 of less than -10dB.
- ◆ Innovative structures
 - Adding two semi-circle elements at the back of the E-shape stub elements
 - Extending the top of the E-shape stub element with an inverted L-shape element with a “suspending hammer” element
 - Etching two semi-circle slots on the rectangular ground with two step-like structures to realize ultra-wideband
- ◆ The dimension of the substrate is $24 * 44 * 1.6mm^3$

Antenna Performance-1

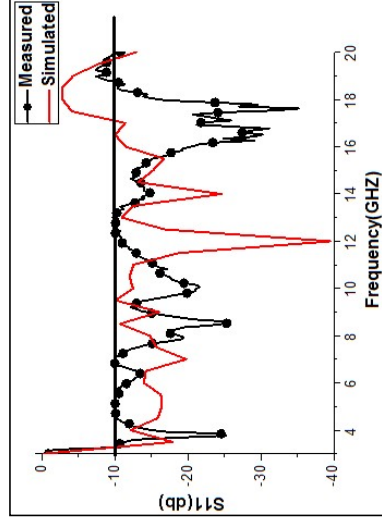


Fig. 2 Simulated and measured S11

- ◆ The simulations and measurements are similar, but the measured bandwidth is wider.
- ◆ The bandwidth of S11 of less than -10dB ranges from 3.2GHz to 18.7GHz and the relative bandwidth of the antenna is 142%.

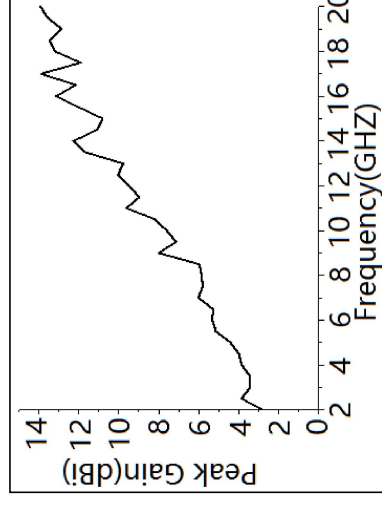


Fig. 3 Peak gain of the antenna

- ◆ The antenna's peak gain is higher than 3dBi in its working band, and the antenna's peak gain rises as the frequency rises.

Antenna Performance-2

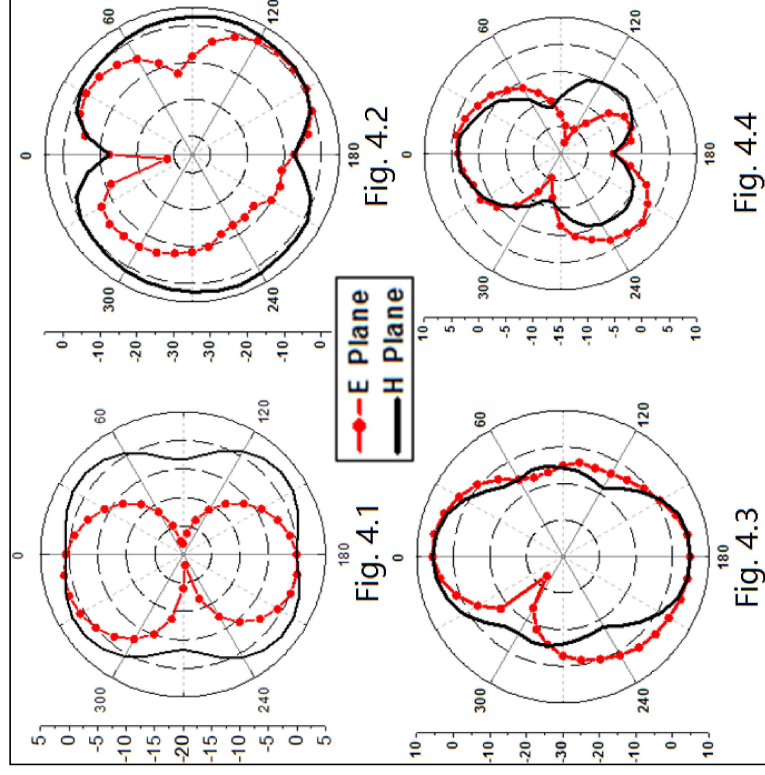


Fig. 4 Simulated radiation pattern of the antenna at 4 discrete frequency

Fig. 4.1 shows the radiation patterns at 3.5GHz.
Fig. 4.2 shows the radiation patterns at 7GHz.
Fig. 4.3 shows the radiation patterns at 9GHz.
Fig. 4.4 shows the radiation patterns at 12GHz.

In the lower frequency band the antenna has a circular H-plane pattern of the good omnidirectional performance.

In the higher frequency band, the radiation pattern changes a bit.

Design Evolution-1

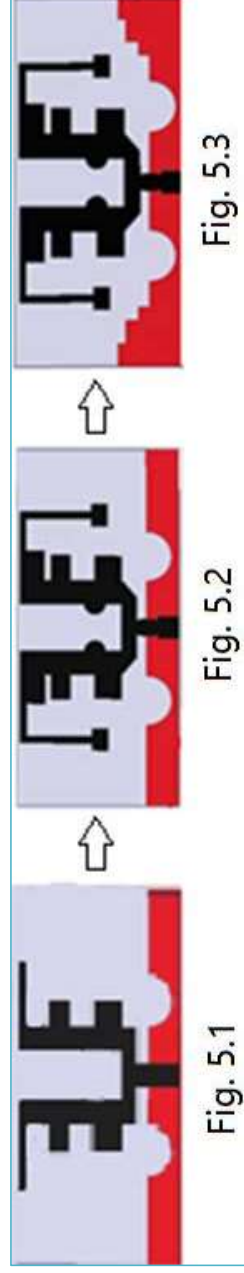
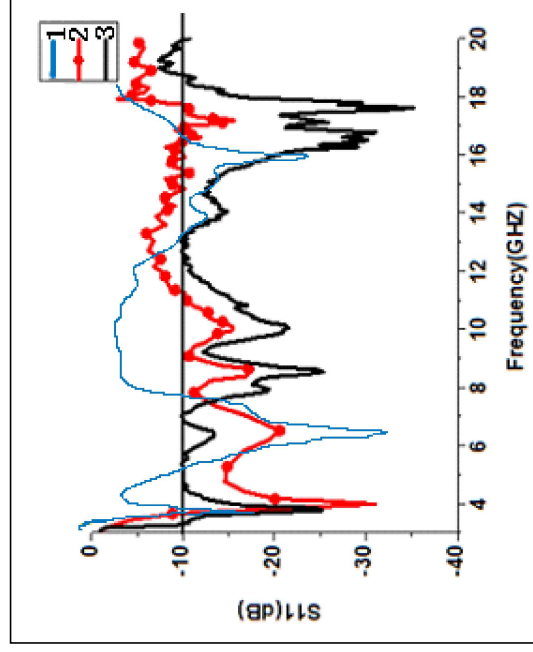


Fig. 5 The design evolution of the antenna

The antenna shown in Fig.1, named the third state, is evolved from the first state(Fig. 5.1), and the second state(Fig. 5.2).

- ◆ From the first state antenna to the second state antenna
- Adding small semi-circle elements at the back of E-shape stub elements.
- Extending the top part of each E-shape stub element with a “suspending hammer”.
- ◆ From the first state antenna to the second state antenna
- Using two step-like structures forming the V-shape ground with some semi-circle and step-like loopholes.

Design Evolution-2



- ◆ The S11 parameters of the designed three state antennas are respectively expressed by Curve 1, 2 and 3.
- ◆ The S11 of less than -10dB on the second state antenna is better than that of the first state antenna.
- ◆ The third state antenna has the best S11 performance getting 142% of the bandwidth ranging from 3.2GHz to 18.7GHz.

Fig. 6 S11 of each antenna of the design evolution

Conclusions

- This paper proposes an E-shape-like novel multi-stub ultra-wideband planar monopole antenna.
- By changing the rectangular ground into V-shape ground with some semi-circle and step-like loopholes, the antenna has a good ultra-wide band performance of 3.2GHz-18.7GHz which means S_{11} less than -10dB and has a peak gain of over 3dBi.
- It is indicated that the stub antenna will have ultra-wide band performances and stable performances by changing the ground and loading the radiation patch properly.

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